

NEW FORMAT

# FOREN

ONLINE

2020

7-10 SEPTEMBER

## ENERGY TRANSITION IN SOUTH EAST EUROPE: OPPORTUNITIES, CHALLENGES, PERSPECTIVES

7<sup>th</sup> | **QUO VADIS ENERGY SECTOR?**  
8<sup>th</sup> | **REGIONAL ENERGY DAY**

9<sup>th</sup> | **DISCUSSION SESSION I**  
SCIENTIFIC PAPERS  
10<sup>th</sup> | **DISCUSSION SESSION II**  
SCIENTIFIC PAPERS

**DISCUSSION SESSIONS SUMMARY**

THIS YEAR, THE 15TH EDITION OF FOREN, ORGANIZED BY WEC/RNC WILL BE HELD ONLINE, DURING 7-10 SEPTEMBER 2020.

The decision was made due to the extension of the alert state on the Romanian territory caused by the spread of SARS-CoV-2 and the restrictions imposed on organizing scientific events.

**WORLD ENERGY COUNCIL** | **COMITETUL NAȚIONAL ROMÂN**



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## 1.1. SMART STRATEGIES FOR THE TRANSITION IN COAL INTENSIVE REGIONS. CASE STUDY: JIU VALLEY MICRO-REGION – STEPS FORWARD UNDER TRACER EUROPEAN PROJECT

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**Abstract:** The TRACER project supports nine coal-intensive regions around Europe to design (or re-design) their Research and Innovation (R&I) strategies, industrial roadmaps and decision support tools in order to facilitate their transition towards a sustainable energy system. The TRACER consortium consists of the following target regions: South East Bulgaria, North West Bohemia - Czech Republic, Lusatian Lignite District - Germany, Western Macedonia - Greece, Upper Silesian Coalfield - Poland, West Region, **Jiu Valley - Romania**, Wales – UK, Kolubara - Serbia, Donetsk - Ukraine. TRACER activities include the identification and analysis of best practice examples of successful and ambitious transition processes in coal intensive regions; a detailed assessment of social, environmental and technological challenges; an EDP (Entrepreneurial Discovery Process) to mobilise a wide range of stakeholders in each regions; the elaboration of guidelines on how to mobilise investment as well as dedicated activities to stimulate R&I cooperation among coal intensive regions in Europe and beyond. This paper will present Jiu Valley diagnosis in terms of technological, environmental and social state of play.

**Keywords:** energy transition, coal intensive regions, R&I strategies, industrial roadmaps, social challenges, re-skilling.

## 1.2. ELECTRICITY REVIVAL FROM DARK TO BRIGHT

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**Abstract:** Global warming concern affect our life and new ideas are coming in our day to day business, including electricity. Renewable generation, integrated power markets, digitization, the conservation and efficiency use of electricity are included in R&D projects and are coming daily in our life. Traditional way of project promotion based on feasibility study is obsolete. Some steps in order to evaluate the social benefit are introduced by different CBA (Cost Based analyse) which are trying to monetize social benefit like green gas reduction and creation of skills to the people. Generally speaking, distributed generation looks to be in conflict with global transmission grid. The scope of this paper is to demonstrate, one more time that electricity is one key driver for social development and is a must from many points of view. The 5 D concept is explaining WHY and WHERE the power system should go. Also, this new and old ideas should be aggregated in a state-of-the-art concept which allow a revival of the power sector in the next decades.

**Keywords:** Distributed generation, Global transmission grid, Renewables, Efficiency, Democratization, Decarbonization, Deregulation, Decentralization, Digitization, Millennium generation.

### 1.3. TECHNICAL POLICY REGARDING THE ACTIVE HEALTH CENTER OF CNTEE TRANSELECTRICA SA

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**Abstract:** This paper has a tactical character and it presents the main points of Romanian TSO's Technical Policy regarding digitalization of the assets within the modernization initiatives, Part IV, „Asset Health Center Concept”, center that will integrate and operationalize the objectives set by the Company through a series of strategical documents. This technical policy will be applied by the organizational entities of the Company, by the design service providers and also by the working staff, for different projects such as: full implementation of Asset Health Center concept, a digital substation pilot project, elaboration of different documentation or studies, and it was made taking into consideration „best in class” solutions.

**Keywords:** Assets, APM, Digitalization, Monitoring

### 1.4. RENEWABLE SOURCES COMPETITIVENESS TO COVER R. OF MOLDOVA ELECTRICITY DEMAND

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**Abstract:** Sunt examinate 7 scenarii de dezvoltare a surselor de energie electrică pentru R. Moldova, inclusiv 100%SRE pentru acoperirea cererii. Acest din urmă poate fi realizat prin atragerea în soluție construcția turbinelor pe gaze (TG), - ca sursă de energie pentru echilibrarea intermitenței SRE. Scenariul acoperă cererea la nivelul de 70% direct de la SRE și 30% de la TG, fiind competitiv cu scenariul asincron de racordare la ENTSO-E, promovat de țară la moment. Competitivitatea devine sesizabilă la o investiție de cca 750US\$/kW pentru sursele eoliene, - valori promițătoare, conform estimărilor IRENA.

**Keywords:** 100%SRE, securitatea energetică, scenarii energie electrică

### 1.5. ELECTRICITY PRICE FORECAST USING MACHINE LEARNING

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**Abstract:** Forecasting the price of electricity has become a very important topics since the liberalization of the electricity market in Romania. Market participants need a good short-term price forecast model to bid their best offer on the market. Due to the high volatility, the sharp increases in prices and seasonality, it is necessary to develop and maintain complex models for price forecasting. Nowadays, improvements in computing capabilities have enabled a fast training process for machine learning models. This paper presents the results of a proposed model based on machine learning developed internally by the Tractebel consulting team in Romania for the forecast of electricity prices for day ahead market.

**Keywords:** electricity price, forecast, machine learning, day-ahead market

## 1.6. ABOUT „HIDDEN” CO2 EMISSIONS

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**Abstract:** For the first time at national level the work addresses, by quantified examples, categories of CO<sub>2</sub> emissions (hidden) which are not calculated and recorded in statistics: a) associated with losses in electricity networks; b) embedded in materials/products; c) embedded in energy services. For category „b”, an ecological criterion is proposed, focused on „CO<sub>2</sub> emissions embedded in the material of the overhead power lines pillars”. In the latter category, the author proposes two ecological performance indicators for repair work: 1. (Es)-„absolute emission embedded in service" (kgCO<sub>2</sub>); 2. (es)-„absolute emission divided to the financial value of service" (kg CO<sub>2</sub>/Euro).

**Keywords:** CO<sub>2</sub> emissions; network losses; emission factors; product/equipment life cycle; energy embedded in materials/products; CO<sub>2</sub> emission embedded in maintenance materials/services.

## 1.7. DISTRIBUTED GENERATION – OPORTUNITY TO INCREASE ENERGY SECURITY

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**Abstract:** The Republic of Moldova is 75% dependent on the import of energy resources. The 80% of electricity consumed in the Republic of Moldova is imported from Ukraine and the Cuciurgan power station, which is not in the administration of local authorities. This dependence of energy import essentially reduces the country's level of energy security. The paper analyzes the possibility of distributed generation of electricity in cogeneration. The paper results show that distributed generation can reduce the import of electricity by 50%. Energy losses in transport and distribution lines are reduced by approximately 4MW. At the same time, the cumulative capacity of the local generation sources can reach 192MW.

**Keywords:** distributed generation, energy security, CHP, transport lines.

## 1.8. MODELING OF DISTRIBUTED GENERATION

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**Abstract:** In this paper are presented the main aspects of distributed generators aimed at determining the characteristics regarding their parameters, either network, photovoltaic or wind, on a group of consumers. The characteristics will be determined and analysed in the Matlab-Simulink simulation and modelling program. Following the determinations, the operation of the renewable energy sources on the consumers connected to the grid and their effects on the electrical grid will be analysed.

**Keywords:** Matlab-Simulink, distributed generators.

## 1.9. DESIGN OF A RENEWABLE ENERGY SUPPLY SYSTEM FOR A STUDENT DORMITORY

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**Abstract:** This paper aims to study the electrical installation of the C4 student dormitory on the USV campus, for which a renewable energy supply system will be designed. The paper presents some general aspects of the theory of designing a photovoltaic system and the analysis of the electrical installation. The study also looks at energy consumption and efficiency.

**Keywords:** renewable sources, photovoltaic system, energy efficiency.

## 1.10. IT'S TIME FOR OFFSHORE WIND AND OFFSHORE HVDC AT THE BLACK SEA

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**Abstract:** In this paper, we emphasize the opportunity to capitalize Romania's offshore wind potential by creating fixed and floating offshore platforms and by using HVDC- type solutions for the transport of produced electricity.

**Keywords:** offshore floating wind farm, offshore HVDC, wind power energy.

## 1.1. BEHAVIOUR OF THE MEASUREMENTS DATA ORGANISED IN LONG AND VERY LONG TIME SERIES. RELATED FORECASTS BASED ON PROBABILITIES.

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**Abstract:** The quasi-unexplored field of long and very long time series of measurements data have a controversial behavior and evolution. The work includes a critical approach of the trends of such evolution and behaviour. The author shows what kind of forecasts could be obtained and especially the pitfalls of the classical approach. The work includes also an approach to a new forecasting method, adapted from the new simulation methods. The influence of the subjective control and adjustment of the measurements is discussed.

**Keywords:** Measurements Data Mining, Qualitative forecast (based on long time series).



## 2.1. THE EVOLUTION OF THE REGULATORY FRAMEWORK REGARDING THE BALANCING MARKET AND THE FINANCIAL IMPLICATIONS

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**Abstract:** OPCOM SA, related to its 15 years of experience, has chosen the data of the last 4 year of Settlement Operator for Balancing Market and presents some interesting facts regarding the evolution of this market through regulation framework established by ANRE.

OPCOM SA, as a Settlement Operator for Balancing Market, has to determine the rights to receive and the obligations to pay for the Balancing Market Participants, BRPs and OTS.

It is important to point out that in all these years, OPCOM SA did not have any contest from the participants.

**Keywords:** Balancing Market, Dispatchable Unit/Consumer, price-quantity offers, UP/DOWN power regulation, Net Contractual Position, Net Measured Position, payment obligations, rights to receive

## 2.2. IMPLEMENTATION OF CROSS-ZONAL INTRADAY CAPACITY PRICING

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**Abstract:** This paper is describing how the cross-zonal intraday capacity pricing will be implemented across the pan-European level by applying a market coupling mechanism between the bidding zones, which means that a price for the intraday cross-zonal capacity can be determined. It is specified how the cross-zonal intraday capacity pricing was proposed, the solution that was selected and a short description of the implemented solution and the current status of development.

**Keywords:** ACER, IDA, SIDC, SDAC, CACM, TSO, NRA, XBID

### 2.3. EUROPEAN SHORT-TERM ELECTRICITY MARKET: PLANNING, STATUS, PERSPECTIVES

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**Abstract:** The scope of the paper is to present the purpose of the single market concept, actual status, and prospects, as well as a few dates concerning the evolution of trading in the context of gradually transition to single European market.

MCO plan establishes the target model for the short-term market trading skyline. Romanian market is part of the 4M market coupling and strive to couple with MRC to reach the target of SDAC as enduring solution.

The Romanian NEMO (Nominated Electricity Market Operator) and TSO (Transmission System Operator) are involved in developing a series of projects for evolution of the Single European Energy Market, SDAC (Single Day-Ahead, respectively DE-AT-PL-4M MC (known as Interim-coupling) project, CORE FB MC (known as Core Flow-Based Market Coupling project) and SIDC (Single Intra-Day Coupling (previously known as XBID), respectively all that involve development so that to implement all regulatory requirements.

**Keywords:** MCO Plan, NEMOs, Interim coupling, Core flow-based

### 2.4. THE SOLUTION IMPLEMENTED AT OPCOM LEVEL TO SUPPORT ENERGY INVESTMENTS THROUGH LONG-TERM PPAS

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**Abstract:** Starting with 1st of September 2020, the Centralised Market for awarding Long Term Electricity Contracts (PPA) (PCTL) has become fully operational, after going through a public consultation process. This new market allows the negotiation and the conclusion of long-term electricity sale-purchase contracts, the seller being an economic operator who will build and connect a new capacity to produce electricity or to produce electricity and heat in cogeneration.

**Keywords:** PPA, electricity market

### 2.5. A PEER-TO-PEER ENERGY TRADING MODEL FOR SMES

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**Abstract:** Since the advent of smart grids and prosumers, new energy trading models have emerged and the energy industry faces the challenge of integrating digital technologies to accommodate these changes. This paper provides a review of Peer-to-Peer energy trading, where energy from small-scale distributed energy resources is traded among local energy prosumers and consumers. The main advantages and challenges of such platforms are discussed in the context of integrating a small-scale generation system. The paper also elaborates the architecture of a smart energy management system of a building having a solar generation system and storing the excess energy in crypto currency.

**Keywords:** Peer-to-Peer energy trading, distributed energy resources, crypto-currency

## 2.6. ECONOMIC ASPECTS OF PROSUMERS USING PHOTOVOLTAIC INSTALLATION AND APPLYING THE NET METHOD SUPPORT SCHEME

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**Abstract:** The purpose of the present paper is an economic and technical analysis of the prosumers using the electricity produced on the basis of photovoltaic technologies (PVh), using the support scheme net metering. The paper highlights a comparative calculation that can be used by potential investors in PVh technologies to calculate and justify investments.

**Keywords:** prosumers, photovoltaic installations, net metering

## 2.7. TRENDS IN THE EUROPEAN RESEARCH IN THE DOMAIN OF HEATING AND COOLING SYSTEMS WITH GEOTHERMAL HEAT PUMPS – RESEARCH PROJECTS FINANCED BY THE EUROPEAN COMMISSION (CHEAP-GSHPs AND GEO4CIVHIC)

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**Abstract:** The EU policy in the domain of energy and the environment has largely promoted the use of renewable energy sources for heating and cooling. One of the most promising technologies able to provide high energy efficiencies and low carbon emissions is the reversible geothermal heat pump. The paper presents the main research directions financed by the EU in this domain, with emphasis on the Cheap-GSHPs and GEO4CIVHIC projects.

**Keywords:** geothermal energy, geothermal heat pumps for heating and cooling, energy efficiency, low carbon emissions.

## 2.8. PROVIDING GREATER FLEXIBILITY FOR HIGH PENETRATION RENEWABLE INTEGRATION

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**Abstract:** The Republic of Moldova is a robust state in which Polichinelle's secret in the context of great challenges which highlights the increased adaptability, the flexibility of the energy system, the technological evolutions, as well as the absorption of the global tendencies - requires higher learning skills (exit from the templates). Thus, the energy that will continue to be used will be exclusively from renewable sources - the future belongs to renewable energy. In order to respond to major trends at the international level in the energy sector, the situation existing at the state level must be recognized, understand the direction and provide benefits to compensate for shortcomings and finally to improve continually the international competition. Active participation in a cost-effective energy transition to ecological decentralized systems, with a high degree of digitization, as well as dynamic prosumers, requires research and innovation in all sectors of energy systems.

**Keywords:** energy transition, flexibility, energy storage, digitization.

## 2.9. MODELLING OF THE NATIONAL ENERGY SYSTEM DEVELOPMENT SCENARIOS

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**Abstract:** This paper presents the modelling results of the possible Moldova's energy system development scenarios by 2050. The climate neutrality scenario highlights the need of the integration the electricity storage technologies, as well as carbon capture and sequestration technologies, without which emission neutrality is not possible.

**Keywords:** modelling, optimization, development scenarios, sustainability, decarbonization, climate neutrality, flexibility, energy self-sufficiency.

## 2.10. INCREASING FLEXIBILITY OF THE NATIONAL ENERGY SYSTEM BY USING BUILDING UP HYDRO PUMPED STORAGE PLANTS

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**Abstract:** The present paper deals with the problem of building up a 100 MW hydro pumped storage power plant (HPSPP) in the Republic of Moldova. The main technical characteristics of the plant have been determined (quantity of water to be pumped, the upper and the lower reservoir dimensions, etc.). Several possible plant locations were investigated and finally an indicative assessment of the plant economic feasibility has been carried out.

**Keywords:** energy system flexibility, renewable energy sources, electricity storage, hydro pumped storage power plant.

## 2.11. USE OF LI-ION BATTERIES FOR INTERNAL SERVICES IN TRANSELECTRICA SUBSTATIONS AND RELATED CONSUMPTION FLEXIBILIZATION

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**Abstract:** This paper aims to analyze the hypothesis of using Li-Ion batteries in order to reduce the costs of electricity required for the internal services of Transelectrica substations. Using the higher capacity of Li-Ion batteries compared to acid technology, this surplus can be used to power internal AC services, combined with the purchase of electricity for internal services on the Day-Ahead Market.

**Keywords:** Li-Ion batteries, internal services, Transelectrica

## 2.12. RELIABILITY AND MAINTENANCE OF WIND POWER SYSTEMS

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**Abstract:** The paper presents the basics on the reliability and maintenance of wind power generation systems. The positive and negative practical aspects of the operation of a monitored wind system shall be analysed and the strategies applied to perform maintenance of this system shall be presented in the most commonly known variants: Corrective maintenance, preventive maintenance and predictive maintenance. Defect analysis of the main components of the wind system is carried out in order to improve its reliability.

**Keywords:** Wind turbine, maintenance, reliability, electrical equipment.

## 2.13. ANALYSIS OF DIFFERENT METHODOLOGIES FOR THE CALCULATION OF POLLUTANT EMISSIONS FROM VEHICLES

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**Abstract:** Emissions from road transport are a key category in the Energy module. Their values are large, and the transport sector has become a key category also in the total emissions in the country. In this regard, the methodology for calculating emissions from transport plays an important role in adequately assessing real emissions. European countries and a number of countries on other continents use COPERT and other special programs. For Moldova, the use of software is done for the first time. Ways to overcome a number of difficulties are described. The experience gained allows made to another quality level of calculations for this category.

**Keywords:** Emissions, greenhouse gases, inventory, pollutants, road vehicles, COPERT, experience, speed, driving mode.

## 2.14. CASE STUDY REGARDING THE USE OF FINEAMIN TREATMENT IN THE FEED WATER CIRCUIT FOR THE TECHNOLOGICAL STEAM GENERATORS OF AMMONIA PRODUCTION

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**Abstract:** The FINEAMIN polyamine treatment is currently being used more and more throughout the world in water-steam-condensate circuits from power and industrial plants using conventional fuels. FINEAMIN is a continuous treatment with volatile amines and film forming polyamines. The product has the role of dispersing existing deposits and protecting the metal from the action of oxygen and carbon dioxide through a film of polyamines. The study aims to analyse the effects of the use of polyamines in the treatment of feed water at technological steam generators in the production of ammonia.

**Keywords:** treatment, polyamines, environmental impact reduction, power generation, steam boilers, corrosion prevention, ammonia.

## 2.15. FROM SMART METERS TOWARDS SMART GRIDS

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**Abstract:** According to the UE directives, Smart Metering has to reach the level of 80% in 2020 and 100% in 2022. So, Smart Metering is a first step to increase the process of implementing digital technologies to achieve a Smart Grid and a new energy market, involving the consumers. The new challenges of the global digital revolution need special attention regarding the implementation of these new solutions into the National Power System. In this context, the paper presents the achievements in the digital technologies deployment and how to accelerate this process.

**Keywords:** Smart Grid, Smart Metering, power systems, energy management, energy market

## 2.16. CHARACTERISTICS OF TWO CHANNEL STATIC FREQUENCY CONVERTER

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**Abstract:** The object of research is a static transformer frequency converter based on PSF (phase-shifting transformer) with a circular rotation of the output voltage phase relative to the input, made according to the "zigzag-triangle" scheme and controlled by power keys, which can be used to combine parallel-operating power systems having different operating frequencies or standards for maintaining frequency. The aim of the work was to study operational characteristics and evaluate various strategies and laws for controlling the device in order to improve the quality of power transmission via electrical interconnection lines, containing a frequency converter based on the results of computational experiments obtained during structural-simulation modelling. The research results help to determine the feasibility and technical efficiency of the use of new types of converters for combining asynchronously operating power systems.

**Keywords:** intersystem communication, static frequency converter, phase-shifting transformer, active power deviation, current non-linear distortion coefficient.

## 2.17. THE IMPACT OF WATER TREATMENT IN THE ENERGY SECTOR ON THE ENVIRONMENT

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**Abstract:** Water is an important factor in ecological balance, and its pollution is a current problem with more or less serious consequences on the population. By water, pollution is understood to alter the physical, chemical and biological characteristics of the water, produced directly or indirectly by human activities and which makes the water unfit for normal use for purposes where such use was possible before the alteration occurred. The effects of pollution of water resources are complex and varied, depending on the nature and concentration of the impurities. Solving these problems raised by water pollution is achieved by treatment, which ensures the necessary conditions for consumption.

**Keywords:** waste water, treatment, environment, impact.



## 2.18. INVESTIGATION OF STEADY-STATE ASYMMETRIC MODES OF FOUR-WINDINGS THREE-LEG CONVERSION TRANSFORMER WITH EXTENDED DELTA CONNECTION

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**Abstract:** The work is devoted to calculation and investigation of steady-state asymmetric modes (such as different short circuits and phase breaks) of 4 winding three-phase three legs conversion transformer, containing an extended delta connection. The previously proposed mathematical model in the MATLAB package was used, which take into account the electromagnetic coupling of windings located on different legs. As the initial data the usual catalogue parameters of the power transformer are used, such as the nominal values of capacity and rated voltages of the windings, short circuit voltages of the windings pairs, power losses in the no-load and short-circuit modes, no-load current, as well as similar additional data for the zero sequence parameters, that could be measured on existing transformer or provided by the manufacturer. The presence of extended delta connection substantially changes the behaviour of the transformer in asymmetric modes. Due to appearing of mutually compensating zero sequence currents in such transformers usually are not occurring modes with exit of magnetic flux from the core.

**Keywords:** 4-winding three-phase three-leg transformer, delta extended windings connection.

## 2.19. PROSUMERS: STANDARDS' REQUIREMENTS AND THE SAFE OPERATION OF THE POWER DISTRIBUTION NETWORK

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**Abstract:** According to the international standards, the EU regulation and the relevant ANRE norms, it is necessary to have appropriate measures both in terms of electrical protections at the interface between the network and the prosumer, as well as in the generating plant. To ensure a safe operation is very important to properly configuring and parameterizing the protections. The integration of the prosumers in the electrical distribution networks starts with the proper choice of the protections. The management of electricity generation and load flows are important at the network level, but the first step in integrating the distributed generation is the operational one in which we must determine how these installations will work and how they will be protected against abnormal regimes. Integrating distributed generation into the network and developing a microgrid concept requires a clear and fine-grained understanding of how electrical protections must be achieved for these applications. The prosumer, unlike the passive consumer of electricity, can consume, store or sell electricity into the grid. By this behaviour and his additional capabilities is an active participant in the electrical grid. As the car drivers are interested in the state of the roads and often they signal to the other traffic participants the problems that arise, so the prosumer must be a participant responsible for the state of the electrical network and the impact of its own installations on it. The term "active participant" first implies a new level of responsibility. The electrical protections seen as the basic solutions for integrating prosumers are presented in this article.

**Keywords:** prosumer, standards, electrical protection, safe operation.

## 2.20. SURGE ARRESTER FOR PROTECTION AGAINST OVERVOLTAGE OF HIGH VOLTAGE POWER LINES

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**Abstract:** The paper presents the main elements of surge arresters used in high voltage electrical networks. A comparison is made between the main characteristics of surge arresters, both in terms of the construction elements and in terms of the technical and functional characteristics of surge arresters.

**Keywords:** overvoltage, surge arrester, high voltage network, protection.

## 2.21. WHEELCHAIR WITH SOLAR PANELS

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**Abstract:** The wheelchair is the essential movement mobility device for people with disabilities. On the Romanian market there are only the classic chairs, ie manuals that cause to the user during the ride the injury of the upper limbs and acute fatigue. There are also electronic chairs that reduce the risk of injury but they are high in price and large, which prevents efficient handling. The present study presents the modelling and execution of a wheelchair, with electric propulsion supported by an auxiliary solar energy supply system. Following a test I noticed that the supply with the solar system can increase the radius of travel by 26% compared to a battery-only power supply, ie electronically. The prototype will have a modular design so it can be easily handled, transported and stored. The solar panel of the chair will serve as protection against external factors such as: excessive sun, snow and rain. The proposed solar wheelchair offers a sustainable means of mobility for people with disabilities. In the paper, it is proposed that the production of the prototype be a social business and are the form of a social enterprise through which the necessary financing can be obtained to put into practice. It is encouraged that the technological flow be executed by the disabled persons with final product destined for all the same social categories.

**Keywords:** Solar Wheelchair, Prototype, Design, Urban mobility, smart city, social business, social enterprise, inclusion.

## 2.22. POSIBILITIES FOR REALIZATION AND TECHNOLOGICAL PROBLEMS OF HYDROELECTRIC POWER PLANTS WITH PUMP STORAGE IN ROMANIA

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## 2.23. THE IMPORTANCE OF THE ANALYSIS OF TECHNOLOGICAL RISKS IN PROJECT MANAGEMENT OF INVESTMENTS IN THE HYDROPOWER FIELD

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## 2.24. ZERO HOUR FOR CLIMATE ACTION. INTELLIGENT DECISION-MAKING FOR SUSTAINABLE MANAGEMENT OF ENERGY

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**Abstract:** On November 29, 2019, the EU parliament declared „climate and environmental emergency”. The biggest challenge of humanity is happening NOW and is accelerating. Planet Earth in its entirety is impacted like never before. The ecosystems are struggling and every single living creature is affected. Greenhouse gas levels in the atmosphere also hit record high leading to changes in the duration and intensity of natural phenomena which seem to turn into real disasters. Carbon dioxide emissions resulting from the use of fossil fuels in economic and industrial activities have a drastic impact on climate change. There is a close relationship between urbanization, economic growth, energy demand and consumption, energy production, industry, transport, greenhouse gas emissions and climate change. Currently, this seems to be a vicious cycle that can be turned into a positive new paradigm by enhancing synergies among them. It is not a matter of simply changing anymore, it is about acting smart. In a modern world, intelligent leaders can successfully use super-intelligent digital technologies to reduce global greenhouse gas emissions. A new age of green growth is emerging through integration of renewables. The embedding of new technologies and artificial intelligence solutions in the energy infrastructure will radicalize decision-making and improve workflows, thus creating a new future of clean energy.

**Keywords:** climate emergency, sustainable energy management, artificial intelligence, decision making, intelligent control.

### 3.1. NATIONAL INITIATIVES REGARDING THE ADOPTION OF INNOVATIVE MEASURES TO REDUCE ENERGY POVERTY, IN THE CONTEXT OF ARTICLE 7 OF THE EUROPEAN ENERGY EFFICIENCY DIRECTIVE - WORK DONE UNDER THE EUROPEAN SOCIALWATT PROJECT

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**Abstract:** In 2018, about 10% of the EU population experienced energy poverty. The extent of the problem has attracted a significant amount of scholarly attention and advocacy work, calling for urgent action at EU and Member State levels, either through social and energy policies or even both. The paper aims at making a radiography of energy poverty in Romania by reviewing the different attempts of defining it and by making an analysis of the EPOV four key primary indicators. Furthermore, the paper introduces the three tools developed by the SocialWatt project for facilitating utilities alleviate energy poverty. Finally, the assessment of energy poverty by identifying energy poor households through the use of SocialWatt Analyser is explored.

**Keywords:** energy poverty, energy poor households, article 7, energy efficiency directive.

### 3.2. DIGITAL SOLUTIONS FOR ENERGY EFFICIENCY AND DECARBONIZATION STRATEGIES

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**Abstract:** The paper presents two digital solutions developed by ENGIE Digital, ENGIE Impact and Tractebel Advisory & Advanced Analytics (T3A): Nemo – a tool to optimize the District Heating & Cooling (DHC) Networks and Prosumer – a tool to harmonize climate change imperatives with business profitability, by designing the investment strategy of zero-carbon journey. These tools are used for and enriched by various studies supporting implementation of energy efficiency and decarbonization investments in relation with private and institutional clients.

**Keywords:** energy efficiency, nemo, strategic planning, energy investments, decarbonization, prosumer.

### 3.3. PHENOMENOLOGICAL MODEL OF THE COGENERATION HEATING PLANT

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**Abstract:** The use of mathematical models to investigate processes in energy systems and their functional components is a priority direction of research. The purpose of the paper is to develop and verify the mathematical model applied for the analysis of technical and economic indices of operation of cogeneration heating plants, which operate in the district heating systems. The investigation methodology is based on the concept of selecting the most significant factors influencing the technical-economic indicators of operation of generation sources. The fuel converted into energy (natural gas) was selected as a significant factor. By processing the technical-economic indices of operation of the sources, the functions of approximation of the production of electric and thermal energy, of the fuel utilization factor were determined, which are the main calculation relationships of the elaborated phenomenological model. The results of the parametric analysis of the evolution of the value added obtained in the transformation of fuel into energy for sets of values of energy supply tariffs and tariffs of the fuel, as well as the results of theoretical calculations and experimental data are presented. The proposed concept of elaborating the phenomenological model is also robust for other types of sources for transforming fuel into energy.

**Keywords:** energy transformation, electrical and thermal power, global efficiency, fuel utilization factor, input-output block diagram, tariff, added value, technical and economic efficiency.

### 3.4. ASPECTS OF THE STUDY OF THE INCREASE OF THE ENERGY EFFICIENCY IN THE OPERATION OF THE INDUCTION MOTORS WITHIN THE ANCILLARY SERVICES OF A THERMOELECTRIC POWER PLANT

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**Abstract:** In this paper, the authors systematized and interpreted the results obtained by running their own design computing programs, developed using the facilities offered by the Mathcad mathematical software package combined with facilities offered by appropriate custom chart wizard, provided by Excel. These programs were developed based on the algorithms for calculating the parameters of the equivalent scheme, the electrical balance components and the energy efficiency indicators (efficiency, power factor) for a three-phase induction motor with squirrel cage rotor with deep rectangular bars within the ancillary services of a thermoelectric power plant, using a complete mathematical model for different degrees of loading.

**Keywords:** energetic efficiency; induction motors with squirrel cage rotor; ancillary services of thermoelectric power plants; loading degree; equivalent scheme parameters; charts of active and reactive powers balance; calculation programs Mathcad, Excel.

### 3.5. CONTRIBUTION OF SYNCHRONIZED MEASUREMENTS TO ENERGY EFFICIENCY OF TWO-WINDING POWER TRANSFORMERS

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**Abstract:** Energy efficiency of power transformers as a key component in the power system networks assumes the knowledge of actual values of the transformer technical parameters. As a rule, technical parameters are obtained from the no-load and short-circuit experiments, and are considered constant values during operation. In fact these parameters may vary considerably especially in the networks with high level of wear equipment. In their turn, technical parameters are used for the passive parameters calculation. This paper proposes the novel methods of passive parameter identification for two-winding transformers by using synchronized measurements on the both windings during operation. There are analysed the methods of parameter identification based on quadrupole equations, currents balance and power balance with one or two sets of measurements. The proposed methods were verified for the real two-winding transformers with different types of windings connection.

**Keywords:** power transformer, synchronized phasor measurements, parameters of equivalent circuit,  $\Gamma$ -form circuit, no load losses, quadrupole coefficients, currents balance, powers balance

### 3.6. ANALYSIS OF THE TECHNICAL CONDITION OF THE TRANSFORMERS IN THE ELECTRIC TRANSMISSION NETWORK

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**Abstract:** Power transformers are considered critical network assets, determining their technical condition is an increasing challenge on the one hand due to the large number installed in the network and on the other hand due to the age of these assets. The paper presents an application made at CNTEE Transelectrica SA, which based on excel tables completed with relevant information about transformers, you can see the evolution over time of the parameters from commissioning the equipment to the last measurement, so you can make optimal decisions with on maintenance actions.

**Keywords:** monitoring, diagnosis, maintenance, transformer

### 3.7. ACTIVE POWER TRANSFER BETWEEN TWO ENERGETIC NETWORKS, OF DIFFERENT WORKING FREQUENCIES, USING A VARIABLE FREQUENCY TRANSFORMER

**Authors:** Anca-Alexandra SĂPUNARU, Violeta-Maria IONESCU, Ovidiu FRĂȚILĂ, Mădălina-Andreea LUPAȘCU, Mihai Octavian Popescu and Claudia Laurența POPESCU

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**Abstract:** Since the growth in usage of Distributed Energy Resources (DER) based microgrids, integrating such systems with one another has proven not to be always a simple task due to the different working parameters. For such an issue, this paper offers a solution in the form of an asynchronous machine working as a variable frequency transformer (VFT), in order to transfer active power between two electric grids operating at different frequencies. This method serves as a better alternative to the traditional inverter reliant conversion systems which generate undesired and harmful harmonics that have a negative impact on the network.

**Keywords:** power grids, active power, variable frequency transformer.



### 3.8. ELECTROMAGNETIC INTERACTION BETWEEN THE POWER DISTRIBUTION GRID AND THE HV SYSTEM OF AN ELECTRIC VEHICLE

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**Abstract:** In the paper it will be presented the history of electric vehicles (EVs), compared to conventional combustion engine cars. Environmental impacts produced the necessity of a cleaner transportation by reintroducing electrical cars in the automotive market. By increasing the EVs used in transportation, the level of pollution is decreased, but some major issues concerning electromagnetic compatibility are raised. The ambient electromagnetic field was described, focusing on simulation of a MV power distribution line. Afterwards, it was analysed the electromagnetic interaction between an electric vehicle and the power distribution line, simulating the magnetic field distribution.

**Keywords:** electric vehicles, power grid, electromagnetic compatibility.

### 3.9. MODELS FOR NONLINEAR DECISIONS OVERVIEW AND 2 CASE EXAMPLES IN FINANCE AND ENERGY

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**Abstract:** The latest years evolution in the financial and economic world have proven one more time that the models used to describe behaviour of given systems should be extended and the approach on which they are based should change from linear to nonlinear. A number of such models are described in the paper with a synthesis of the main features of nonlinear behaviour and a case example is presented on how to describe in order to be able to predict the discontinuous decision associated with the financial crises and with the technological evolution of energy systems. Suggestions are made on the need to control crises not to eliminate them if one wants to better adapt to a nonlinear world dynamic and on the optimal scenarios for the penetration of ALFRED and fuel cell technologies for energy production.

**Keywords:** Nonlinear models, discontinuous decisions, financial crises, energy technologies.

### 3.10. THE IMPACT OF INDIVIDUAL THERMAL STATIONS ON THE ENVIRONMENT AND PUBLIC HEALTH OF THE POPULATION

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**Abstract:** The aim of the paper is to raise public awareness, that the replacement of the centralized system of thermal energy supply by Individual Thermal Power Plants (CTI) in the residential buildings is not the best solution, which creates a serious public health problem, through the multiple aspects in which their use affects the life and health of not only the users, but also of the whole society. The data presented in the paper are systematized based on the municipality of Chisinau.

**Keywords:** individual thermal power station, electric power station with district heating, greenhouse gases.

### 3.11. SYNCHRONOUS MULTI-ZONE SPACE-VECTOR MODULATION FOR CONTROL OF DRIVE CONVERTERS OF TRANSPORT SYSTEMS: A SURVEY

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**Abstract:** This paper presents short survey of novel methods, schemes, techniques, and algorithms of feedforward synchronous space-vector modulation elaborated for scalar control of power electronic converters and induction motor drives for transport systems. Modulation strategy is based in this case on new multi-zone concept for determination of the pulse patterns, and includes novel parameters, algorithms, and control correlations, describing modulation processes in power conversion systems. This review includes both description of features of these new modulation methods, and examples of its development and dissemination for basic topologies of three-phase, five-phase, and six-phase systems (with two, three, and four inverters in systems) for transport application. These alternative methods and algorithms of synchronous pulse width modulation (PWM) allow providing continuous synchronization and waveform symmetries of the phase and line voltages of traction ac drives, with minimization of undesirable sub-harmonics in spectra of voltage and current, and also with minimization of undesirable common-mode voltage in transport-oriented drive systems.

**Keywords:** traction motor drive, voltage source inverter, pulse width modulation, modulation strategy, voltage synchronization, voltage spectra.

### 3.12. MARINE GAS TURBINE FOR EFFICIENT SHIP PROPULSION

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**Abstract:** The paper presents the case of replacing an out-of-date gas turbine with a newer turbine for marine use. The novelty consists in the solution found for the mechanical adaptation due to the reversed gas inlet and outlet ports of the engine, located in opposite positions to those of the old turbine. As well, a customized command and control system was designed and implemented, in full accordance with the requirements of the ship. The tests to which the new turbine was subjected, in regimes close to those of the old turbine operation, have shown that the replacement of the turbines made the propulsion of the ship more efficient.

**Keywords:** marine gas turbine, efficient propulsion.

### 3.13. INCREASE OF ENERGY EFFICIENCY OF ELECTRICALLY DRIVEN DRILLING INSTALLATIONS BY VALORISING THE BRAKING REGIME OF THE DRAW WORKS UPON DESCENDING THE PIPE LINE

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**Abstract:** The paper provides a method and, at the same time, a solution to increase the yield of electrically driven drilling machines by efficiently implementing the technological processes specific to hydrocarbon exploratory drill. It is known that one of these technological processes refers to the execution of deep drill wells (2000-10000 m) by using diamond system drilling installed on the top of a drill pipes driven by a draw works in repeated ascending - descending marches. If, upon ascending such columns, the primary energy is consumed, upon descending in the drilling process, a large amount of potential energy of the soil is lost for many of the drilling machines. This paper presents a method and a solution to use such potential energy in the braking process irrespective of the type of electrical drilling machines.

**Keywords:** Energy, oil and gas, conversion, storage.

### 3.14. AP12 LE - A PROJECT FOR REDUCING THE ENERGY CONSUMPTIONS AND IMPROVE THE ENERGY EFFICIENCY OF THE ELECTROLYSIS POTS

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**Abstract:** ALRO Group is the biggest industrial power consumer from Romania with about 9% produced in the country. The profile of consumption is almost flat 24 hours /day 365days/year, despite that group has four different operational divisions due to equilibration achieved among them. Incessantly increasing energy prices and low London Metal Exchange (LME) aluminium prices have forced aluminium smelters to reduce energy consumption all over the world. Electricity direct and associated costs (associated means – green and CO2 certificates, cogeneration tax, injection fee, transportation, distribution, system services, reactive energy) are the most important differentiators of the competitive structure of the aluminium industry. Over the last few years, successive cost cutting plans have reduced the in-house technical resources available to ALRO smelter. Meanwhile, ambitious projects such as progressively reducing the anode-cathode distance (ACD) so as to lower specific energy consumption (SEC) have tended to further reduce the consumptions of electrolysis, process developed in different ways by well-known players as Norsk Hydro, Rio Tinto, Gami, etc. Rio Tinto Aluminium Pechiney (RTAP) and ALRO entered an agreement in 2018 for the supply of the AP12LE technology to ALRO. To meet this kind of challenge and to guarantee a smooth and reliable improvement in performance, RTAP has developed a whole suite of benchmark tools, including technical support from a location distant from the smelter concerned. This article will present the project for progressively improving performance and describe some of those benchmark tools, including operating window, low ACD operation assessment and development plan, transition plan for moving from the present situation to the new one, go-no go process and remote support.

**Keywords:** Aluminium Electrolysis, Cell design, Low energy, Technology transfer and validation

### 3.15. RESEARCH ACTIVITY IN AIR AND OTHER GASES COMPRESSION AND ENERGY STORAGE

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**Abstract:** COMOTI and its industrial partners have developed collaborative activities on the energy storage possibilities of air, and also on another gases like methane, carbon dioxide, and also hydrogen in exploited and preserved salt caverns, with storage capacities between 50,000 and 500,000m<sup>3</sup>. In applications, research in the energy sector needs partnerships with the energy industry and university medium. The issue of energy storage concerns both the decision-makers and the universities, constituting an important chapter in the energy strategies of the energy producing countries and, implicitly, to increase the Romanian energy security.

**Keywords:** compression, energy storage, air, carbon dioxide, methane, hydrogen.

#### 4.1. THE GEOTHERMAL GRADIENT ANALYSIS FROM THE MOESIAN PLATFORM

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**Abstract:** In this article are presented and simulated series of dates regarding the geothermal gradient distribution in the Moesian Platform, using the temperature measurements done in oil exploration and production wells. Knowing the thermal conductivity and the geothermal gradient of rocks it is possible to estimate the heat flow, one of the main parameters for the thermal state of geological formation characterization. They are presented the main problems of geothermal conductivity of rocks measurements in the laboratory conditions.

**Keywords:** geothermal gradient, thermal conductivity, geothermal flow, rock, simulation, pressure, temperature

#### 4.2. VIBRATION ANALYSIS IN THE PROCESS OF OPERATION A INSTALLATIONS AND MACHINES FROM THE OIL INDUSTRY

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**Abstract:** Vibrations are alternative movements made by the mechanical system in relation to the reference state, being caused by disruptive forces (excitations) whose sizes, directions or points of application vary over time. From the multitude of parameters that, by measuring, give an image of the operating state, the vibrations and noise produced by machines and machines have attracted the attention of researchers, designers, builders and specialists in operation in recent years. Also the vibration and noise offer a high sensitivity to the analysis, but also individuality to the concrete situations, only apparently repeated. The development of vibration and noise measurement techniques, as well as the development of signal processing techniques, have allowed important improvements in the control, monitoring and diagnostic systems. The vibration diagnostics of the state of operation of facilities, installations and machinery in the oil industry is based on the fact that in the energy transfer process, oriented towards the realization of a given function, different components, located on the route of the transfer, can be excited mechanically, and thus the vibration. Monitoring the operation of the installations and machines in operation by the specific parameters of the operating process, by vibration, temperature etc., is recognized as an important way to increase the reliability, operating efficiency, reduce production and operating costs. For use or installation of monitoring systems is to check normality operation, to detect deviations potential "problems" and to provide information, decision support and interventions to disconnect or shutdown and for diagnosis. The accumulation, classification, analysis of these results, gathered in diagnostic databases, with the help of advanced processing techniques, are capable of ensuring, first of all, the objectivity of the diagnosis.

**Keywords:** analysis, gear, coupling, defect, misalignment, diagnosis, magnitude, monitoring, reference spectrum, pumping unit, wear, vibration.

#### 4.3. ELEMENTS FOR THE PREVENTING AND COMBATING CORROSION TO CYLINDRICAL METAL TANK FOR DESTINED STORAGE OF LIQUID HYDROCARBONS

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**Abstract:** Cathodic protection is a method for preventing corrosion on overhead ground and underground metallic structures. Cathodic protection is one of the most effective methods for preventing corrosion on a metal surface. Cathodic protection is commonly used to protect numerous metal structures against corrosion, such: crude oil reservoirs, produs petroliers or liquid for reservoirs, offshore platforms, ships, subsea equipment, pipelines, tanks etc. The simplest method to apply cathodic protection is by connecting the metal to be protected with another more easily corroded metal to act as the anode. Zinc, aluminium and magnesium are the metals commonly used as anodes. Stainless steel may corrode either in active or passive state, dependent on the electrolyte conditions. In normal aerated water condition the passive metal has an oxide film that prevents further attack, while the same metal become active and exhibit a potential near 0.5 volts in low-velocity or poorly aerated water. Life prediction of steel in water is challenging for existing structures as well as new. Corrosion is a complex function of many factors such as salinity, dissolved oxygen, stray currents, pH and temperature and more, which makes it difficult to establish predictable rates of degradation. Corrosion rate can be defined as the speed at which any metal in a specific environment deteriorates.

**Keywords:** corrosion, tank, crude oil reservoir, cylindrical metal reservoir, cathodic protection, cathodic protection station, cathode, anode, concentric anode ring system.

#### 4.4. ANALYSIS OF THE RISKS OF THE EXPLOITATION OF THE NEW GAS DISCOVERY IN THE BLACK SEA

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**Abstract:** The Romanian continental shelf of the Black Sea is rich in gas and petroleum deposits. Exploration, development and exploitation activities of natural gas would mean an energy alternative and safety for the Romanian and European energy markets. Exploitation of proved reserves of oil and gas in the Black Sea - Black Sea has the potential to become one of the most important natural gas producing areas in the European Union. All the Black Sea coastal states have exploration projects, with Romania, Turkey and, to some extent, Bulgaria. The development of the offshore natural gas sector is a historical opportunity for our country, which can bring energy, economic and social security benefits. International energy security means bilateral treaties between countries ensuring mutual security, regional institutions that help preserve international security, global international organizations, alliances in multilateral formats, and last but not least international jurisprudence. Progress can be achieved in the security sector regarding energy and transports in a multilateral format of Romania's cooperation with NATO and EU.

**Keywords:** projects offshore exploration, development, exploitation, drilling ship, natural gas extraction, pipeline, environmental risk, fiscal risk, political and geopolitical risks, technological risks, energy security.



#### 4.5. ELEMENTS CONSTITUENT FOR THE DESIGN OF A RISER SYSTEM IN AREAS DEEP WATER AND EXTREME DEEP WATER APPLIED FOR OFFSHORE DRILLING

**Authors:** Marius STAN , Valentin-Paul TUDORACHE, Lazăr AVRAM Mohamed Iyad Al NABOULSI, Claudiu TĂNASĂ and Georgeta ALECU;

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**Abstract:** Riser systems are integral components of the offshore developments used to recover oil and gas stored in the reservoirs below the earth's oceans and seas. These riser systems are used in all facets of the development offshore process including exploration and exploitation wells completion/intervention, and production of the hydrocarbons. Their primary function is to facilitate the safe transportation of material, oil and gases between the seafloor oceans and seas and the marine platform. As the water depth increases, the working conditions of this system becomes challenging due to the complex forces and extreme environmental conditions which are impacting the operational mode as well as the stability. In this paper several aspects concerning riser mechanics and the behaviour of the riser column will be evaluated against different operational situations.

**Keywords:** deep water and extreme deep water, oil, gas, riser system, drilling platform, marine currents, pressure, temperature, effort, wave.

#### 4.6. ENERGY IMPROVEMENT OF AN OIL INJECTED SCREW COMPRESSOR SKID

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**Abstract:** Energy efficiency of a screw compressor skid, after 80,000 hours of operation, by introducing a lubrication pump for oil flow in the lubrication and injection system, eliminating the need to increase the discharge pressure by strangling the discharge, so that the oil can circulate through installation due to pressure in the separator vessel. So, the electric motor is overloaded and the required electric power for compressing the gas increases significantly.

**Keywords:** screw compressor installation, natural gas compression, energy efficiency.

#### 4.7. DETERMINATION OF FOAMS AND THE CONGELATION POINT OF MIXED SOLUTIONS FOR EVACUATE OF THE LIQUIDS FROM THE BOTTOM OF THE WELL THE WITH AID OF AUTOMATED DEVICES INTRODUCTION FOAMING ON THE WINTER PERIOD

**Authors:** Horațiu Raul OLAR, Lazăr AVRAM, Marius STAN , Valentin-Paul TUDORACHE and Petru GHERMAN;

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**Abstract:** In this study we will axis on introducing liquid foam substances into gas wells using automated devices during winter when temperatures are low and a solution such as methanol or triethylene glycol is needed in the water + foam mixture to avoid frost, that we proceeded in the laboratory of physico-chemical determinations to determine the freezing point of a mixing pallet, respectively of the tendency of foaming of these mixtures, foaming necessary to evacuate the liquids from the bottom of the well.

**Keywords:** wells, automated devices, solution, experiment, laboratory, congelation point, methanol, triethylene glycol.

## 4.8. THE CHALLENGES AND SOLUTION OF IMPLEMENTING A LEAK DETECTION SYSTEM ON A COMPLEX CRUDE OIL PIPELINE NETWORK IN ROMANIA

**Authors:** Harry SMITH, Kirsty McNEIL, Tom RECORD, Cosmin DUMITRAN, Dan BUZATU, and Georgian ILIESCU;

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**Abstract:** This paper discusses the implementation of the Atmos Wave Flow leak detection system on the Conpet crude oil pipeline network, the challenges faced on the project, solutions implemented and the extensive testing the leak detection system went through to be accepted by Conpet.

**Keywords:** Pipeline leak detection system, Atmos Wave Flow, complex crude oil pipeline network, Conpet

## 4.9. GAS MARKET OF THE REPUBLIC OF MOLDOVA BY 2030: CHALLENGES AND OPPORTUNITIES

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**Abstract:** The results of the study on the demographic evolution and the consumption of natural gas in the Republic of Moldova are weighted in the post-accession period to the Energy Community and their forecast until 2050. The study can be as information in the activity of the decision-making bodies in the field when updating the Energy Strategy of the Republic of Moldova until in 2030 for the period up to 2050 in the chapter on the development of the natural gas system of the Republic of Moldova, the planning of investments in the storage capacities, in the transport and distribution networks necessary for the diversification and guarantee of the continuity of the supply of natural gas to the consumers.

**Keywords:** Energy Community , Republic of Moldova, demographic evolution, population number, natural gas consumption, period 2010-2050, quantitative forecast.

## 4.10. INFLUENȚA DIFICULTĂȚILOR TEHNOLOGICE ALE SONDELOR ASUPRA POTENȚIALULUI ENERGETIC AL ZĂCĂMINTELOR DE GAZE NATURALE

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**Abstract:** The energy potential of a commercial natural gas field is estimated from the complex stage of the exploration works, which include, among others, geochemical analyses, 2D and 3D seismic investigations, exploration drilling etc. The favourable results obtained from this stage open the way to the next stage, namely that of achieving the optimum number of the exploitation wells. This is the stage after which the dimension of the energy potential is well outlined and a series of technical-economic forecasts can be made regarding the performance in the exploitation of the reservoir. The behaviour in time of the respective commercial field is largely conditioned by the reservoir characteristics as well as the state of the productive infrastructure, which is comprises the wells, the surface facilities, the drying and gas compression stations, environmental protection installations etc. This article will present a series of difficulties of the wells frequently encountered in the activity of the exploitation of the natural gas fields, the impact of the malfunctions on the performance of the reservoir and some approaches to overcome them.

**Keywords:** gas wells, technological problems, energy potential.

## 5.A.1. THE CONTRIBUTION OF NUCLEAR POWER TO THE FUTURE ENERGY MIX. GLOBAL, EUROPEAN AND NATIONAL PERSPECTIVES

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**Abstract:** The presentation regarding the contribution of nuclear energy to the future energy mix, as part of FOREN 2020 conference, enlists the main evolutions at global, European and national level with regards to the role of nuclear power in decarbonization, the benefits related to energy security and sustainable development as well as the challenges faced by nuclear power in the context of the Green Deal. In Romania, nuclear power ensures 33% of the total low carbon emissions energy production and ensures 11.000 jobs having an annual contribution of cca 590 million Euro to the GDP. The further development of nuclear power in Romania is provided in the national energy strategy, as well as in the National Integrated Plan for Energy and Climate Change 2021-2030. A series of investment projects are under development or analysis: the refurbishment of Cernavoda NPP Unit 1, Units 3 and 4, the Tritium Removal Facility, the generation IV reactor Alfred, the production of Cobalt 60 at Cernavoda NPP, the implementation of the SMR technology, the production of hydrogen from nuclear sources. Nuclear power continues to be an important pillar of decarbonization policies and it is necessary to ensure a legal framework at the EU and national levels to support R&D, development, innovation and implementation of new nuclear projects.

**Keywords:** energy, nuclear, Cernavoda, nuclear power plant, investments, refurbishment, Units 3 and 4, tritium removal facility, jobs, Green Deal

## 5.A.2. CONCEPTUAL DESIGN AND LAYOUT OF THE COOLING TOWERS NECESSARY TO REMOVE HEAT FROM THE CONDENSER SECONDARY CIRCUIT OF THE ALFRED DEMONSTRATOR REACTOR

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**Abstract:** In this paper it will be presented designing calculation of a cooling tower battery required to remove heat from turbine condensers from secondary circuit of ALFRED reactor. The proposed cooling system it is in closed circuit, having as final cooling agent ambient air in forced circulation, solution feasible for future layout of future ALFRED demonstrator reactor. In this paper it will be presented also layout proposal and technical solution chosen for removing heat from turbine condenser

**Keywords:** ALFRED reactor, Cooling towers.

## 5.A.3. THE DEVELOPMENT OF THE RESEARCH INFRASTRUCTURE IN SUPPORT OF ALFRED DEMONSTRATOR IMPLEMENTATION IN ROMANIA

**Authors:** Marin CONSTANTIN, Giacomo GRASSO, Mariano TARANTINO, Pietro AGOSTINI, Marco CARMELLO, Michele FRIGNANI, Alessandro ALEMBERTI, Ilie TURCU, Constantin PAUNOIU, Alexandru TOMA, Daniela DIACONU, Mirela NITOI, Minodora APOSTOL and Daniela GUGIU

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**Abstract:** ALFRED (Advanced Lead Fast Reactor European Demonstrator) project aims to build a 125 MWe demonstrator as a crucial step towards the commercial deployment of LFR technology and for the development of the LFR-Small Modular Reactor. In order to support the licensing process and the research on the open issues a dedicated infrastructure was planned. It consists of six experimental facilities and a coordination Hub. The paper presents this new infrastructure, its planned operation in synergy with other international centres. The main focus is on the novelty of the concepts and their huge potential to boost the applied research in Romania.

**Keywords:** nuclear, generation IV, research infrastructure, open issues.

#### 5.A.4. FAILURE ANALYSIS AND PREVENTION IN NPP METALLIC STRUCTURES AND COMPONENTS: CASE STUDY

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**Abstract:** The goal of the current study was the analysis of one threaded rod from the elastic suspension of the raw water pipelines from CNE Cernavoda to identify the causes that led to its breakage. For the failure analysis, fracture surface of the threaded rod was investigated using laboratory techniques: optical microscopy, scanning electron microscopy, energy dispersive X – ray spectrometry(SEM-EDS) and mechanical tries (Brinell hardness). The conclusion was the failure of the threaded rod was caused by improper mounting, the presence of a hard impurity in material and the usage of a material with greater hardness than the one specified in the project.

**Keywords:** failure analysis, threaded rod, elastic suspensions of pipelines.

#### 5.A.5. RADIATION EFFECTS ON THE PROPERTIES OF CONCRETE USED IN NUCLEAR POWER PLANTS

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**Abstract:** Inside the concrete used as a material for the protection shields against ionizing radiation coming from the core of the reactor, various processes and physical and chemical reactions have to be taken into account when the efficiency of the shield is analysed throughout the operation life of the nuclear power plant. The paper looked at how the concrete can be affected by the irradiation with neutrons and gamma radiation under conditions of possible high fluence outside an reactor core.

**Keywords:** protection against ionizing radiation, shielding, concrete.

#### 5.A.6. ESTIMATION OF THE RADIONUCLIDE INVENTORIES PRODUCED IN THE STRUCTURAL MATERIALS OF THE REACTOR CORE AT THE END OF THE OPERATING LIFETIME

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**Abstract:** An initial assessment of radionuclide inventories that will need to be managed following the refurbishment of a nuclear power plant can be useful in establishing measures and means of waste management and radiological protection. This type of waste poses problems that are related mainly to the existence of very long life isotopes and high radiotoxicity and may represent a radiological hazard for long time management. In this paper, the inventories of radioactive isotopes produced during the operation of a CANDU 600 reactor were estimated for different components in the reactor core, such as reactivity control mechanisms, pressure and calandria tubes, and end shields.

**Keywords:** activation products, reactor core, refurbishment waste.

## 5.A.7. ASPECTS CONCERNING THE OPTIMIZATION OF PROTECTION AGAINST IONIZING RADIATION DURING REFURBISHMENT OUTAGE OF UNIT 1 CERNAVODA NPP IN VIEW OF LONG-TERM OPERATION

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**Abstract:** The objective of this paper is to analyze the international experience and present lessons learned from the optimization of protection against ionizing radiation during refurbishment outages of CANDU NPP's. Life extension projects have already been successfully completed at Wolsong-1 in South Korea, Point Lepreau, Bruce in Canada and Embalse in Argentina. Many of the lessons learned from the refurbishment of these nuclear facilities allow performance improvement of a refurbishment program and can be applied at Cernavoda NPP Unit 1.

**Keywords:** refurbishment, nuclear power plant, protection against ionizing radiation.

## 5.A.8. ASSESSMENT OF THE TREATMENT CAPABILITY AND OPTIONS TO ENHANCE THE PERFORMANCE OF THE DECONTAMINATION SYSTEM OF AQUEOUS RADIOACTIVE WASTE FROM CERNAVODA NPP

**Authors:** Mirela Dulama, Marius IORDACHE, Liliana SAMSON, Alexandru NEDELICU and Viorel TOBOSARU

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**Abstract:** In CANDU plants, the decontamination of liquid waste is performed by the LRWS (The Aqueous Liquid Radioactive Waste System). The process is based on filtration and ion exchange, using a cellulose-ion exchanger premix. The study has estimated the treatment capacity of the product used at Cernavoda NPP, depending on the composition of the waste. The data obtained were validated experimentally and a calculation algorithm was developed to establish the volume of real waste that can be treated efficiently in the decontamination system installed at Cernavoda NPP. Also, the addition of an advanced treatment step, using selective ion exchangers, to the decontamination system, was studied.

**Keywords:** radioactive waste, decontamination, ion exchange, nuclear power plant.

## 5.A.9. MECHANICAL FATIGUE TESTS OF SEU-43 FUEL BUNDLE CLADDING AT 400°C

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**Abstract:** This paper presents the testing method of samples worked from Zircaloy-4 tubes ("as-received" metallurgical state), utilized as cladding for the new CANDU SEU-43 fuel bundle. These tests are intended to simulate the cladding's behavior in a power cycling process inside the reactor. The testing process is of low cycle fatigue type, done outside of the reactor, on "C-ring" samples, which are mechanically tested at 1%, 2% and 3% total amplitude deformation, at a temperature of 400°C. To determine the deformation for both types of tube (small and big diameter), a numerical simulation was done, using a finite element analysis in the ANSYS commercial computer code.

**Keywords:** fatigue, SEU-43, 400°C, ANSYS.

## 5.A.10.SMR IMPLEMENTATION IN ROMANIA. SITTING CHALLENGES

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**Abstract:** RATEN-CITON specialists, with a rich experience in sitting nuclear objectives, whether they are NPPs or radioactive waste repositories, are faced with a new challenge: to locate a SMR on an industrial site in decommissioning. The major challenge is to adapt a new, innovative technology, to the specific conditions of the site and to the legislative requirements of Romania.

**Keywords:** SMR, sitting.

## 5.A.11.LONG TERM ASSESSMENT OF NUCLEAR TECHNOLOGY PENETRATION USING MESSAGE - THE CASE OF ROMANIA

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**Abstract:** The paper is doing a long-term simulation of the nuclear technology penetration for the Romanian power system. Using the IAEA MESSAGE optimization model. The horizon taken into consideration is 2050 and 2070. The production and the demand are considered with various scenarios and the emissions of CO<sub>2</sub> are also evaluated. The results are destined to assess the impact of the nuclear technology on the implementation of the EU energy and climate change policy on a long-term basis such that to eliminate short term effects in the power system. Given the specifics of the Romanian power system both electrical energy and thermal energy (CHPs) are considered in the main scenarios.

**Keywords:** nuclear energy system, modelling energy system, CO<sub>2</sub> emissions mitigation, electricity and heat cogeneration, energy system security.

## 5.A.12.COMPARISON BETWEEN FEMAXI-6 AND TRANSURANUS PREDICTIONS REGARDING MOX FUELS BEHAVIOUR

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**Abstract:** The purpose of the present paper is to assess fuel performances codes capability to predict mixed oxide (MOX) fuel behaviour. In this respect, two computer tools were used, TRANSURANUS and FEMAXI-6 for the simulation of two experimental rods loaded with MOX fuel. Codes predictions were compared with experimental measurements. The results presented in the current paper are: fuel centerline temperature, volume of fission gas release, fuel rod internal pressure and pellet-clad diameter gap, and the values obtained are plotted only for those models which agree fairly well with the measurements. As a general conclusion, MOX fuel behaviour is reasonably predicted with TRANSURANUS and FEMAXI-6.

**Keywords:** MOX fuel, FEMAXI-6, TRANSURANUS, key models.



### 5.B.1. THE IMPORTANCE OF MAINTAINING OLTENIA'S LIGNITE PRODUCTION FOR ELECTRICITY GENERATION IN ROMANIA

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**Abstract:** In the 21st century, mining can be the basis of the country's well-being, and in order to be able to look to the future, it is necessary to evaluate the present correctly. Romania has in the subsoil of its territory important deposits of useful mineral substances, of which the lignite deposits have a special importance. Romania must accept coal as an important pillar in energy security in the medium term and implement policies that will accelerate innovation and investment in the rapid development of clean coal technologies, so I believe that this resource cannot be suddenly abandoned. This position contrasts with the well-known policy of encouraging the transition from coal safety to less secure energy sources (wind, water or sun), but considered clean, and with the major European policy of closing coal mines.

**Keywords:** national security, energy security, open pit mining, lignite.

### 5.B.2. ORADEA – BEST PRACTICE EXAMPLE FOR IMPLEMENTING ENERGY EFFICIENCY PROJECTS USING EUROPEAN GRANTS

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**Abstract:** The paper aims to show the development of the city of Oradea towards a higher energy efficiency, the efforts made to improve the district heating system as well as the heat generation facility, mean while reducing customers heat losses. Several European financed projects are presented in order to exemplify the success story of the Municipality of Oradea, both in the above-mentioned systems and in using a valuable resource – the geothermal water lying beneath the city.

**Keywords:** Municipality of Oradea, European projects, development, energy efficiency, geothermal water.

### 5.B.3. WATER POLLUTION IN JIU VALLEY AS A RESULT OF MINING ACTIVITIES

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**Abstract:** This paper analyses and monitors an important environmental factor, namely water. This is one of the essential factors for fulfilling the conditions necessary for the existence of life on Earth. The studied geographical area is situated in an intramontane region situated on the Jiu River called the Jiu Valley, where the main economic activity is mining. The importance of studying this area is related to the effect of coal mining on the water.

**Keywords:** environment, pollution, water, coal, sensors.

#### 5.B.4. AN ANALYTICAL APPROACH TO COGENERATION UNITS ECONOMIC SIZING, THAT TAKES INTO ACCOUNT THE EVOLUTION OF VARIABLE PARAMETERS OVER LIFETIME

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**Abstract:** In this paper the problem of getting formulas for calculating the optimal share of cogeneration within a heat supply system for a consumption zone / node is considered. Optimization criterion - the minimum of the total discounted cost during the study period, related to the considered sources of energy (cogeneration units and hot water boilers). The consumption regime is presented by the annual classified heat load curve, described analytically by Sochinsky-Rossander equation. The applied mathematical model takes into account the evolution over time of a series of parameters such as the selling price of the electricity produced, the purchase price of fuel and other factors. In addition, several approaches to the problem are considered - for different operating regimes of energy sources. The obtained analytical expressions to determine the optimal share of cogeneration were tested, demonstrating a coincidence of the results with those got by applying the method of evaluation and comparison of variants.

**Keywords:** annual classified thermal load curve, cogeneration, optimal share of cogeneration, discounted total cost, total revenue.

#### 5.B.5. STUDY OF THE DISTRICT HEATING SYSTEMS WITH CHP AND HEAT PUMPS

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**Abstract:** The work relates to the problems of using heat pumps in district heating systems. The aim of the study is to increase the energy economic efficiency of combined heat supply systems with heat pumps using natural refrigerants. This goal is achieved by developing a scheme of the system in which part of the building is heated centrally from the CHP, and the other part is from a heat pump installed in the building, and heat pump which receives low potential heat from the return network water leaving the part of the building, - centralized, and from outside air.

**Keywords:** district heating, heat pumps, carbon dioxide.

#### 5.B.6. MODERN ASPECTS OF CALCULATION AND ANALYSIS OF THE OPERATING REGIMES OF CENTRIFUGAL PUMPS DRIVEN BY INDUCTION MOTORS, WITHIN THE ANCILLARY SERVICES OF THERMOELECTRIC POWER PLANTS

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**Abstract:** In this paper, the authors present a systematized methodology for modelling and analyzing the operating regimes of centrifugal pumps as working machines in electric drive systems. For solving, algorithms and calculation programs developed in the Mathcad programming environment were designed. For example, a representative case study was chosen of a condensing electric pump from the own services of a thermoelectric power plant with groups of 500 MW, driven by an induction motor with a squirrel cage rotor of 6 kV. It was thus possible to comparatively analyze two solutions for regulating the flow of a centrifugal pump in terms of energy efficiency.

**Keywords:** centrifugal pumps; induction motors; ancillary services; thermoelectric power plants; flow regulation; energy efficiency.

### 5.B.7. MANAGEMENT OF IMPLEMENTING A PILOT PROJECT AT UPB-FACULTY OF POWER ENGINEERING: “HYBRID GEOTHERMAL-SOLAR SYSTEM DEVELOPED TO SUPPLY THE ENERGY DEMANDS OF A BUILDING AND INTEGRATION WITH UPB DISTRICT HEATING NETWORK

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**Abstract:** Within the framework of this article the management system of WEDISTRICT – DEMO Romania is presented. The key performance indicators of energy, economics, environmental impact or social type are explained and analysed throughout the entire project. The general objective of the European project is to demonstrate the possibility of switching off from fossil fuels usage for centralized generation of thermal energy, by optimally integrating different types of renewable energy sources in the existing systems of different European countries. Throughout the project, 10 technologies will be developed, which will be integrated in 4 demonstrators. One of the demonstrators will be developed and integrated and University POLITEHNICA Bucharest.

**Keywords:** renewable resources, solar-geothermal, thermal energy, district heating network, prosumer.

### 5.B.8. TECHNICAL, ECONOMIC AND SOCIAL RISKS ENCOUNTERED IN THE MINE CLOSURE ACTIVITY IN THE JIU VALLEY”

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**Abstract:** Closure of a coal mine is based on a series of specific phased works over periods of time in which it is necessary to take into account a number of technical risk factors to which underground workers are exposed, as well as the open ore body. On top of this is need to add the negative impact of the political and social risk factors, the consequences of which are economic underdevelopment and population poverty. Managing these risks by analysing their causes, assessment and their evaluation, eventual measures to mitigate or anticipate them, to achieve progress or regress, is part of the subject of this paper.

**Keywords:** mine, coal, risk, exploitation, closure.

### 5.B.9. THE LIGNITE FIRED POWER PLANTS PLACE AND ROLE IN DECARBONIZED CONTEXT

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**Abstract:** This paper present what will be the possible role at Romanian lignite fired power plant in the future, in this time when current word is CO2 emissions decrease. Because in next years will be not possible electricity storage for big quantity, the national electricity system operation cannot assure the electricity demand. In this context I propose same solution to cover all consumption demand in next year’s till when capacity storage will enough increase. In my opinion the correct solution for next 10 to 20 year will be the reorganization at Romanian power generation, for both, safety supply and electricity price. In this time the lignite store near power plant it is the real power storage source.

**Keywords:** lignite fired power plant, electricity storage, power generation, safety supply.